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HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

Germany's current situation regarding hybrid and electric vehicles – update October 2014

IEA-IA HEV Task 1 Information exchange
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Vancouver, Canada

Supported by:
Federal Ministry for Economic Affairs and Energy
on the basis of a decision by the German Bundestag

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- Industry – *new models from German OEMs*
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- Summary

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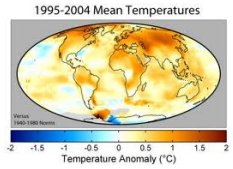
Introduction

Global megatrends



Global warming and reduction of CO2 emissions

Limited fossil resources

Increase of renewable energies

Growth of emerging markets

Motivating factors for HEVs and EVs in Germany

- **EU CO_2 emission target** of 95 g/km in 2021 particularly challenging for German OEMs with high share of large, premium cars
  → Electrification of powertrain important lever to avoid CO_2 penalties
- ***'Energiewende'* (Energy revolution)** High share of renewable energies in Germany; accelerated nuclear power phase-out
  → THG reduction targets -40% in 2020, min. -80% in 2050 compared to 1990
- **Securing future competitiveness of Germany's automotive industry**
  → More than 700,000 jobs at OEMs and supplier (1 out 7 jobs in Germany direct or indirect associated with automotive industry)
  → 12.6 million cars produced by German OEMs in 2010, thereof 75% for export

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German vehicles new at the dealer 2014

- BMW i8

- VW E-up!

- VW Golf GTE

- VW XL1

- Mercedes-Benz S500 PHEV

- Mercedes-Benz B-Class ED

- Audi A3 e-tron

- Porsche Cayenne PHEV

Source: BMW, Volkswagen, autoblog.com, Mercedes -Benz

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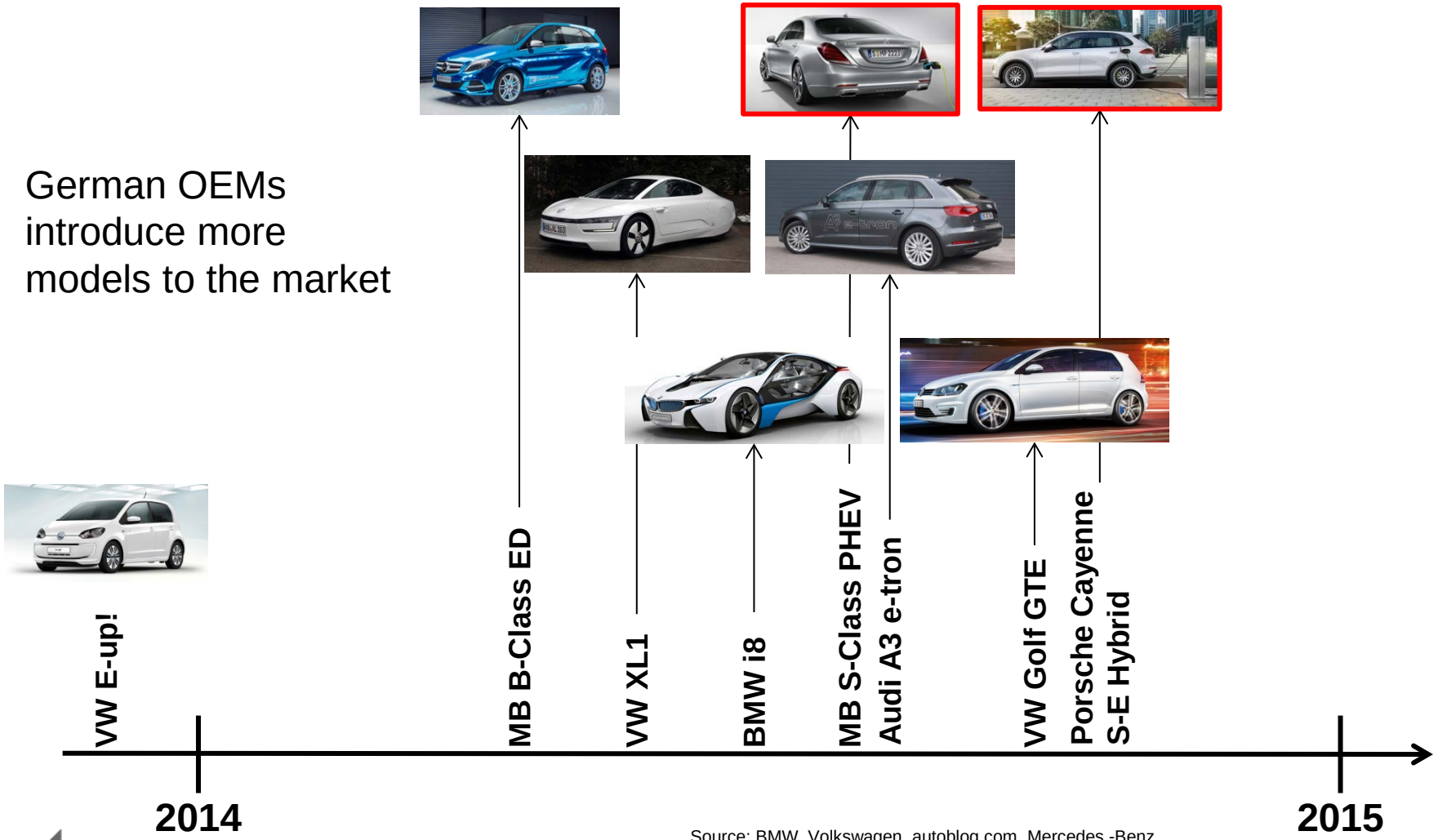
German vehicles new at the dealer 2014

German OEMs introduce more models to the market



Source: BMW, Volkswagen, autoblog.com, Mercedes -Benz

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Industry:
Porsche Cayenne S E-Hybrid

- First Luxury SUV Plug-In Hybrid
  → **other OEMs will follow PHEV SUV Trend**
  → **Volkswagen brands will profit**

- World premiere @ Paris Motor Show 2014
- Technical details:
  - 306 kW total (70 kW electric motor)
  - 10.8 kWh battery capacity (Li-Ion)
  - Electric driving range: 36 km

  } Same powertrain as Panamera Plug-In

  - 3 h charging time (at 3.6 kW charger)
  - 1,5 h charging time with optional 7.2 kW On-board Charger
  - Possibility to drive pure electrically up to 125 km/h

Sources: http://www.porsche.com/germany/models/cayenne/cayenne-s-e-hybrid/concept/character/
http://www.handelsblatt.com/auto/test-technik/porsche-cayenne-luxus-suv-unter-strom/10687316.html

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Industry:
Mercedes strategy - powertrain specific hybridization

- **Diesel Full Hybrid**: S 300 BlueTEC Hybrid
  - 170 kW total (20 kW electric motor)
  - Electric Driving up to 35 km/h

- **Gasoline Plug-In Hybrid**: S 500 Plug-In Hybrid
  - 330 kW total (85 kW electric motor)
  - 8.7 kWh battery capacity (Li-Ion)
  - Electric driving range: 33 km
  - Electric Driving up to 140 km/h

Sources:
http://www.adac.de/_ext/itr/tests/Autotest/AT5165_Mercedes_S_300_BlueTEC_HYBRID_7G_TRONIC_PLUS/Mercedes_S_300_BlueTEC_HYBRID_7G_TRONIC_PLUS.pdf
http://www.mercedes-benz.de/content/germany/mpc/mpc_germany_website/de/home_mpc/passengercars/home/new_cars/models/s-class/w222/facts_/s500pluginhybrid.html

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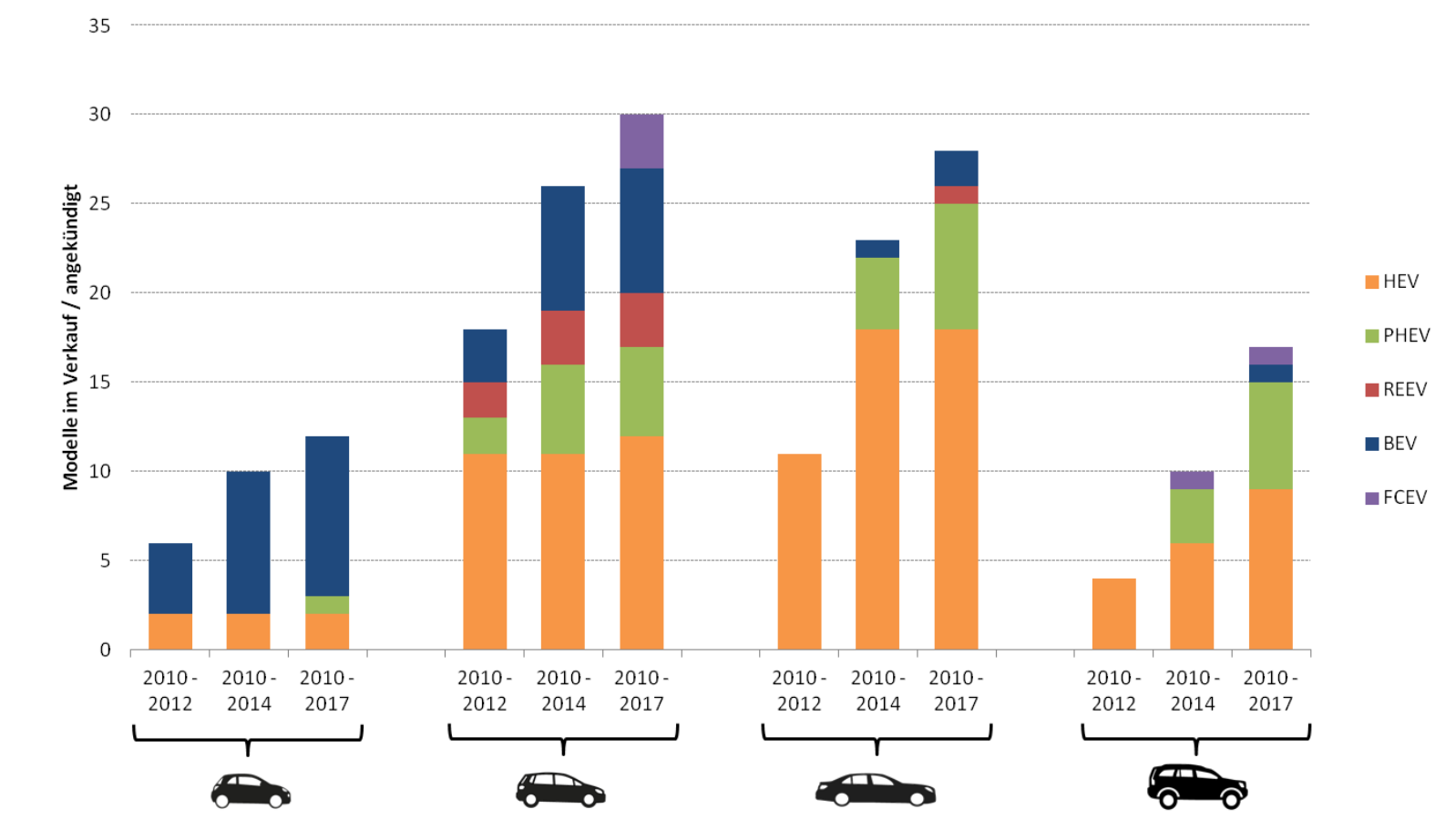
European market overview: EV models on offer/announced



Source: DLR project eMAP

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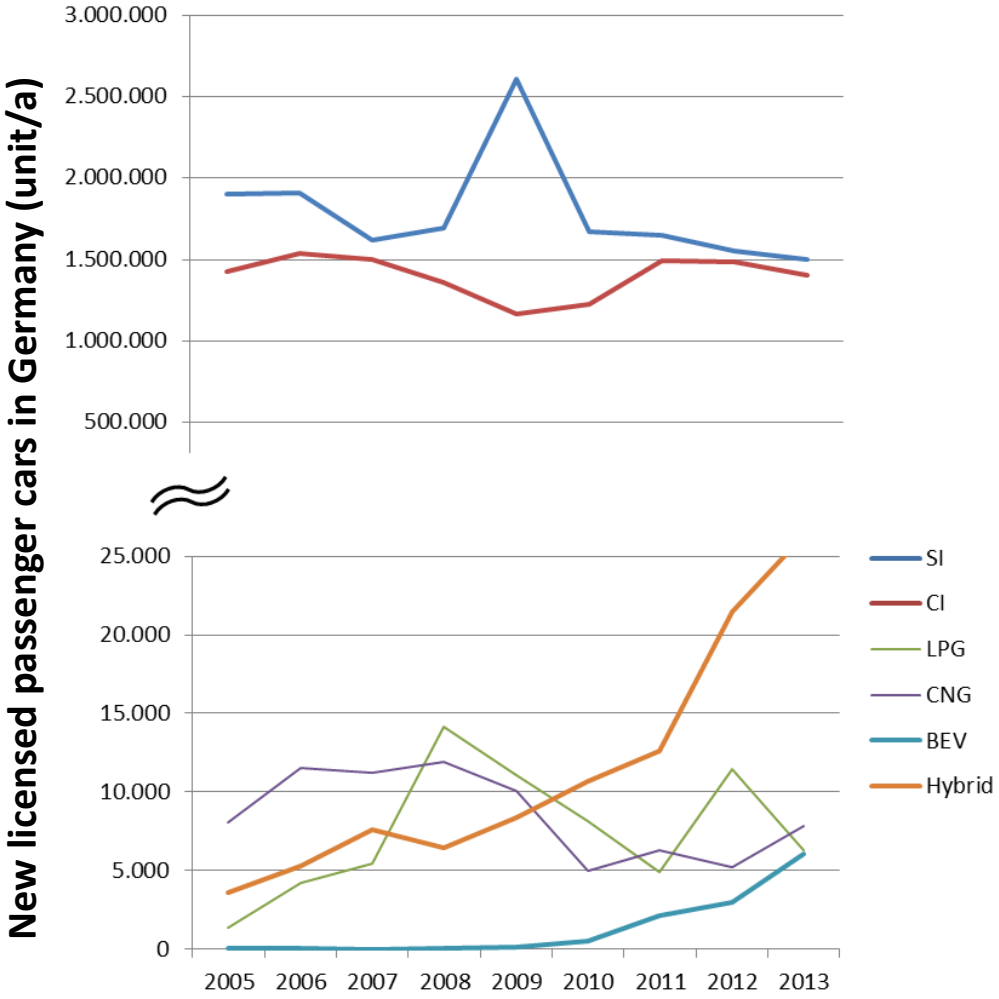
Germany‘s car market



New vehicles in 2013: 2,95 million
(-4,2% compared to 2012)

of this

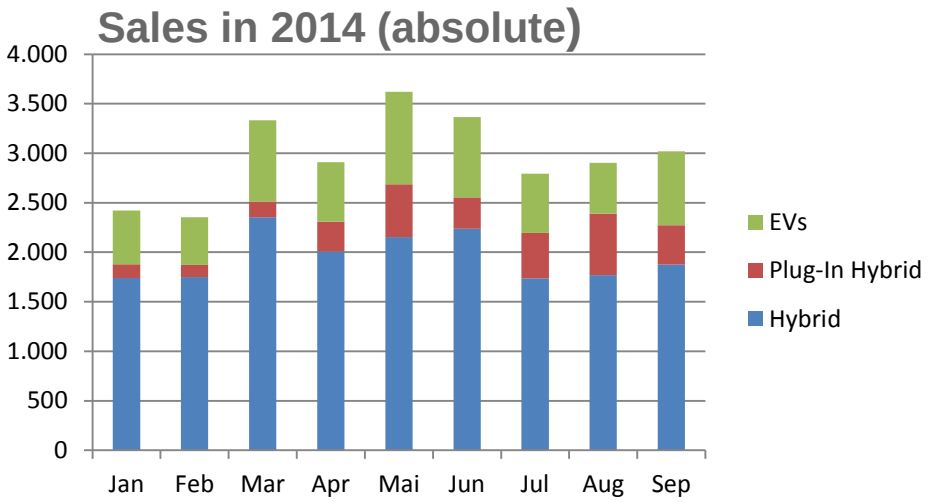
Private: 37,9 %
Diesel: 47,5 %
Alternative powertrains: 1,5%
Avg. CO2 emission: 136,4 g/km
Short-term licensing: 116,000

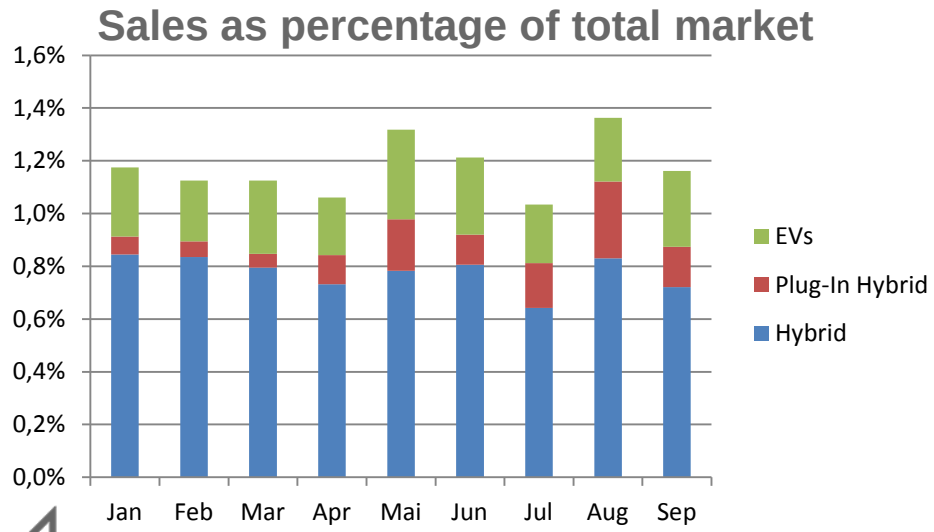
The number of electric cars doubled in 2013 compared to 2012:
6,051 units

- Significant positive trend for Hybrids
- Positive trend for BEV- almost equal to CNG (and LPG)

Source: www.kba.de

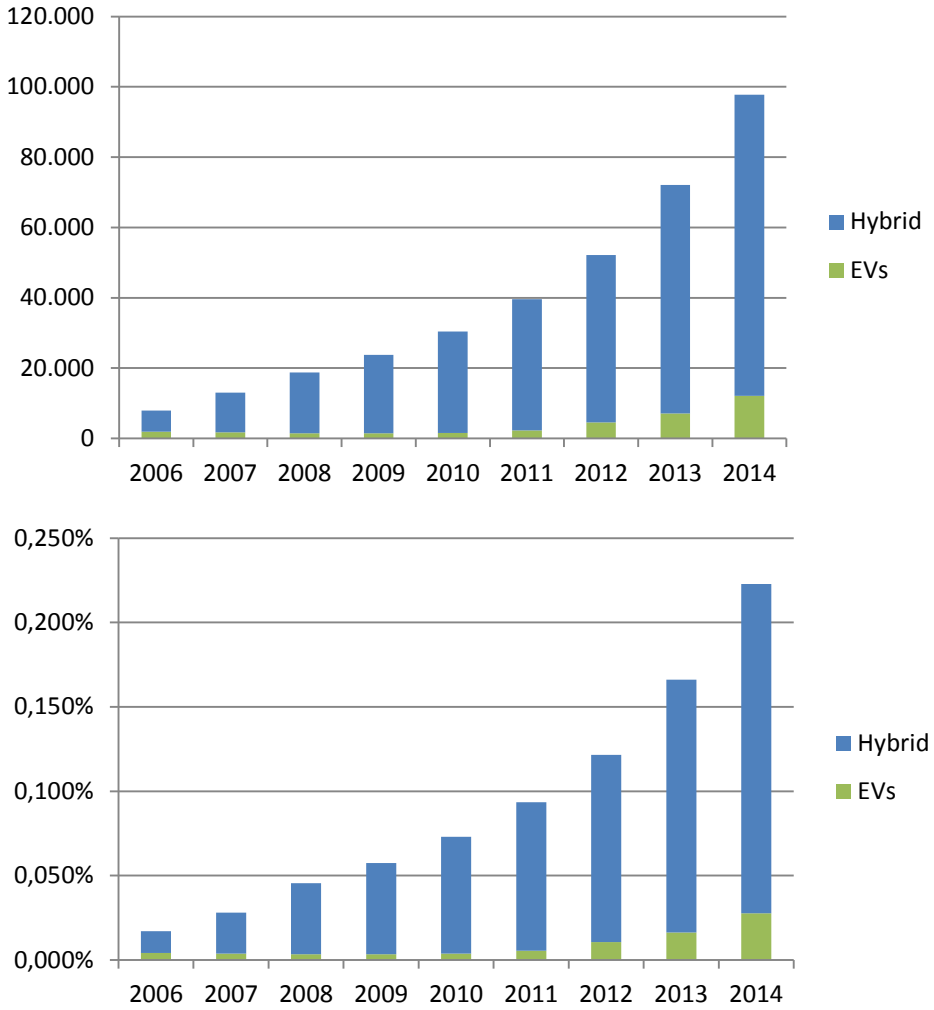
Current sales of HEVs, PHEVs, and BEVs





- New registrations in 2014 (Jan-Sep)
  - Hybrids 20,672
  - of which Plug-ins: 3,053 (15%)
  - BEV 6,047
  - Conventional
    - SI 1.2 million
    - CI 1.1 million
- Increase of purchase in 2014 compared to 2013 (Jan-Sep)
  - Hybrids +8%
  - Plug-Ins +245,8%
  - BEV 56%
- Due to statistical reasons, not all PHEV/REEV are shown

Share of HEVs, PHEVs, BEVs in the car stock



- Share in vehicle stock (1st Jan 2014)
  - Hybrids 0,195%
  - BEV 0,028%
  - CNG 0,18%
  - Conventional
    - SI 68,3% (29.96 mio)
    - CI 30,1% (13.22 mio)

- Sales not progressing as expected: in average 140,000 per annum are needed to reach 1,000,000 in 2020.

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German Government adopts electric mobility law (EmoG)

Content

- Definition of privileged vehicles
- Labeling via number plate
- Parking
- Use of bus lanes
- Access to restricted areas

Mr. Dobrindt, Minister for Transport, and Mrs. Hendricks, Minister for Environment, at the joined press conference, announcing the new law.

Objectives

- To make EVs more attractive

Background

- So far, no jurisdicative foundation to give privileges to EVs
- Not possible to integrate in transport law
- A common way is strived for throughout Germany
- Expected to be ratified spring 2015, EmoG will end on June 30th 2030.

Definition of privileged EVs in the EmoG

- Previous official definition: only BEV and FCEV

Privileged vehicles in EmoG are:

- Battery electric vehicles (**BEV**), incl. cars, light duty vehicles, 2-wheelers
- Environmentally friendly plug-in hybrids (**PHEVs**)
  - With CO2-emissions max equal **50 g/km** or
  - With pure **electric range**
    - more than **30 km**, today to year 2018
    - More than **40 km**, after 2018

Reasoning

- Minimum electric range is sufficient to allow a high degree of electric driving (on average, 80% of cars drive less than 40 km a day)
- PHEVs as a ‚bridging technology' towards complete electrification of the powertrain

Privileges for EVs due to EmoG (1)

Improved visibility/ labeling

- German registered vehicles: new number plate
- Foreign vehicles: sticker

Reasons: to show privileged vehicle, to improve acceptance in society, to help police to enforce the regulation, to demonstrate environmental friendliness

Dedicated parking space

- to enable **cities and communities** to dedicate parking space for EVs at charging stations and/or offer parking space for free or reduced rates

Privileges for EVs due to EmoG (2)

Use of bus lanes / public roads for dedicated uses

- EmoG provides the possibility for cities/communities to introduce the privileged use of bus lanes etc.
- Power of decision is in the cities/communities

- Evaluation of the usage of the dedicated bus lanes can only be done locally
- An additional regulation was put in place to ‚protect' public transport and the safety and easiness of the road traffic flow

Access to restricted areas

- EmoG enables road administrations to excempt EVs from access restrictions due to noise and air quality (Luftkurorte, recreational areas, wohngebiete)

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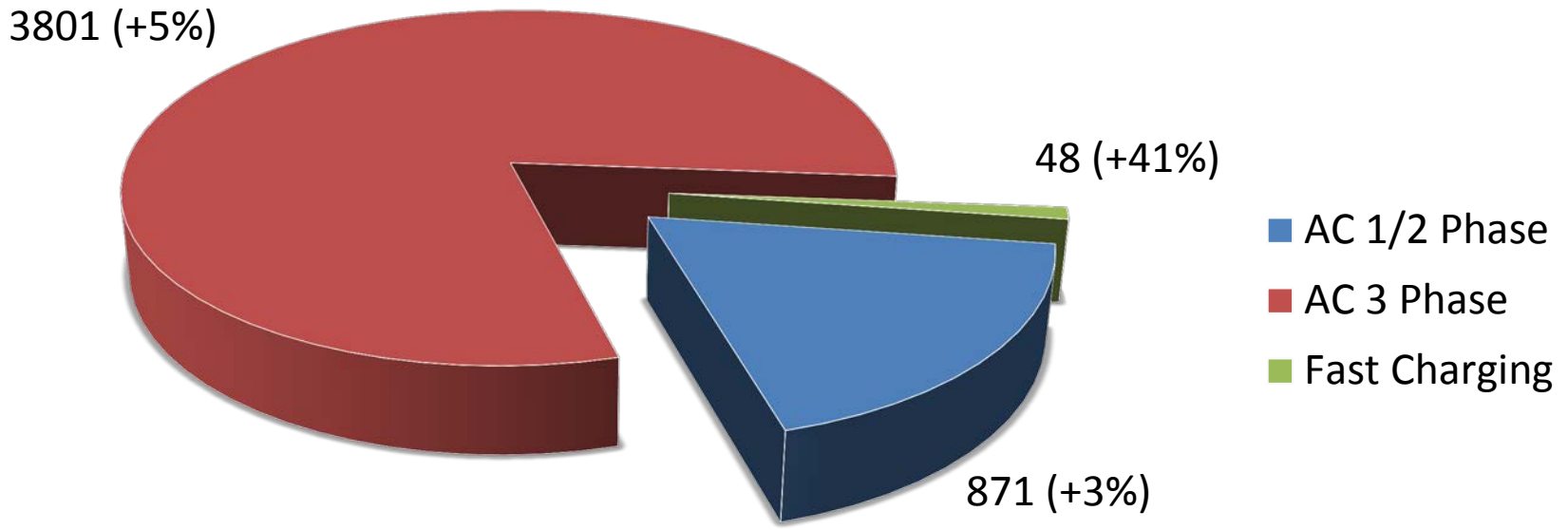
Public accessible EVSE (September 2014)



- Difference to March 2014 shown in parentheses
- AC 1/2 Phase: 230 VAC / 16 A (≤ 7 kW)
- AC 3 Phase: 400 VAC / 32 A (≤ 44 kW)
- Fast charging primarily 600 VDC / 400 A (240 kW) (CCS / CHAdeMO) and some 500 / 250 A (125 kW)

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Ref: Bundesverband der Energie- und Wasserwirtschaft e.V. (BDEW)

Research –Projects started in 2014 (excerpt)

Ministry	Topic	Title of Project
BMWi	**Electric Motors**	**SYNREMO** - Synchrounus Reluctance Machines for Electric Mobility
BMBF	**Urban Logistics**	
BMBF	**Lightweight techn**	
BMBF	**Power Electronic**	
BMBF	**Education**	
BMVI	**Monitoring**	
BMVI	**International Cooperation**	
BMVI	**Demonstration**	
BMU	**Demonstration**	
BMU	**Demonstration**	**Eco Fleet Hamburg** - Electric Mobility in Fleets

German Funding strategy for electric mobility still versatile, including

- **Technologies and components** (e.g. electric machines, power electronics, lightweight design)
- **(Series) production technologies**
- **Demonstration projects** (e.g. fleets, urban logistics)
- **Education and qualification**

BMWi – Ministry of Economics and Energy, BMBF – Ministry of Research, BMVI – Ministry of Tansport and Infrastructure, BMU – Ministry of Environment

Summary

- Number of PEVs and HEV increased in 2014
- A trend in PHEV in upper class and SUV segment can be expected
- New electric mobility law in Germany adopted
  - To make electrified powertrains attractive
  - But without monetary incentives
- Positive trend in new registrations for electrified powertrains
  - HEV – very progressive
  - PHEV – low level, but very strong gradient
  - BEV – constant positiv trend
- Positive trend in charging infrastructure

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DLR Deutsches Zentrum für Luft- und Raumfahrt e.V.

in der Helmholtz-Gemeinschaft

Institute of Vehicle Concepts

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